

**CITY OF SIMI VALLEY**  
**MEMORANDUM**

May 10, 2010

**TO:** City Council

**FROM:** Department of Environmental Services

**SUBJECT:** ENERGY COST EFFECTIVENESS STUDY FOR GREEN BUILDING ORDINANCE

**RECOMMENDATION**

It is recommended that the City Council:

1. Review and accept the findings in the Energy Cost Effectiveness Study prepared by Southern California Edison, which provides the basis of the City Council's determination that the Energy Efficiency Standards (Section 503, as amended by Ordinance 1152) in the City's Green Building Ordinance are cost effective; and
2. Direct staff to apply to the California Energy Commission for approval of the Energy Efficiency Standards.

**BACKGROUND AND OVERVIEW**

On December 7, 2009, the City Council adopted the Simi Valley Green Building Code (Attachment A, page 4), which requires that new construction in the City meet the provisions in the 2008 California Green Building Standards Code, including local amendments related to energy efficiency above California Building Code Title 24 minimum energy standards. Because the energy efficiency standards "reach" beyond the minimum requirements of Title 24, they are commonly referred to as Reach Codes when adopted as a collective set by a local jurisdiction. The process for adopting a Reach Code requires that local governments apply to the California Energy Commission (CEC) for approval.

The CEC requires documentation of the analysis that was used to determine that the submitted Reach Code will save more energy than current standards and that the Reach Code will be cost-effective. Through the City's Local Government Partnership with Southern California Edison to increase energy efficiency and reduce energy use, an Energy Cost Effectiveness Study was prepared for Climate Zone 9, which encompasses the City of Simi Valley. The CEC has established sixteen climate zones for the State, and the utility companies in the State are developing Energy Cost Effectiveness Studies for all zones. The study for Climate Zone 9 is the second such study to be prepared. The CEC has agreed to accept this Cost Effectiveness Study as part of the City's application to the CEC to approve the Reach Code. The attached

Cost Effectiveness Study (Attachment B, page 8) was prepared to incorporate the 2008 Building Energy Efficiency Standards as the baseline for the energy performance analysis.

## **FINDINGS AND ALTERNATIVES**

The Simi Valley City Council adopted the 2008 California Green Building Standards Code by reference, with local amendments that include a Reach Code requiring energy efficiency to reach beyond Title 24 minimum requirements. The City Council determined that the local amendments will be reasonable for new construction and remodeling projects in that: 1) they will not extend the permit review process; 2) plan compliance can be evaluated by existing City staff; and 3) field inspections of construction compliance will be completed within the existing inspection process. The City Council also determined that the ordinance will give the City of Simi Valley the authority and flexibility to incorporate local green building standards as amendments to better serve the public while enhancing public welfare through improved resource conservation and waste reduction.

Southern California Edison (SCE) provided an Energy Cost Effectiveness Study for Climate Zone 9, which includes the City of Simi Valley, at no cost to the City. The Energy Cost Effectiveness Study demonstrates that the Average Incremental Cost increase to exceed the 2008 Title 24 energy requirements by a prototypical 15% across the board ranges from \$0.60 to \$0.80 per square foot for single family residences, \$0.76 to \$0.90 per square foot for multi-family residences, \$0.99 to \$2.58 per square foot for a small office building, and \$0.77 to \$1.67 for a large office building. The average payback, including energy cost savings, ranges from 8-11 years for non-residential buildings and about 15 years for residences. These incremental costs and payback timeframes fall within the CEC guidelines for cost effectiveness and are aligned with the estimates that were provided to the City Council when the Green Building Ordinance was considered and adopted. However, in Simi Valley, the incremental costs for residential construction will be less, and payback timeframes shorter, because the City's Reach Code requires less than 15% above Title 24 minimums; in this case, 10% for new construction and 5% for remodels.

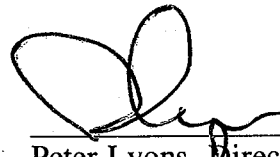
The following alternatives are available to the City Council:

1. Review and accept the findings in the Energy Cost Effectiveness Study prepared by Southern California Edison, which provides the basis of the City Council's determination that the Energy Efficiency Standards (Section 503, as amended by Ordinance 1152) in the City's Green Building Ordinance are cost effective;
2. Direct staff to apply to the California Energy Commission for approval of the Energy Efficiency Standards;
3. Do not accept the findings in the Energy Cost Effectiveness Study;
4. Provide staff with further direction.

Staff recommends Alternative Nos. 1 and 2.

## SUMMARY

The City Council adopted the 2008 California Green Building Standards Code by reference, with local amendments that include a Reach Code that requires energy efficiency beyond Title 24 minimum requirements. The process for adopting a Reach Code requires that local governments document the analysis that was used to determine that the submitted Reach Code will save more energy than current standards, and that the Reach Code will be cost-effective, and apply to the California Energy Commission (CEC) for approval. Southern California Edison prepared a Cost Effectiveness Study for Climate Zone 9, which encompasses the City of Simi Valley. The CEC has agreed to accept this Cost Effectiveness Study as part of the City's application to the CEC to approve the Reach Code. The study demonstrates that the City's Reach Code will save more energy than current standards, by reaching beyond Title 24 minimum requirements, and is cost effective.




---

Peter Lyons, Director  
Department of Environmental Services

## INDEX

## Page

Attachment A: Green Building Code .....	4
Attachment B: Climate Zone 9 Cost Effectiveness Study.....	8

**TITLE 8. GREEN BUILDING CODE**  
**CHAPTER 22. ADOPTION AND AMENDMENTS OF CALIFORNIA GREEN**  
**BUILDING STANDARDS CODE**

**SECTION 8-22.01 ADOPTION.**

- A. Except as otherwise provided for in this Chapter, The California Green Building Standards Code, Part 11 of Title 24 of the California Code of Regulations, including the matrices and appendices thereto, are approved and adopted, and are hereby incorporated in this Chapter by reference and made a part hereof the same as if fully set forth herein.
- B. One copy of the California Green Building Standards has been filed for use and examination of the public in the Office of the City Clerk of the City of Simi Valley.

**SECTION 8-22.02 CROSS-REFERENCES TO CALIFORNIA GREEN**  
**BUILDING STANDARDS CODE.**

The provisions of this Chapter contain cross-references to the provisions of the California Green Building Standards Code, in order to facilitate reference and comparison to those provisions.

**SECTION 8-22.03 LOCAL AMENDMENTS.**

The provisions of this Chapter shall constitute local amendments to the cross-referenced provisions of the California Green Building Standards Code and shall be deemed to replace the cross-referenced section of the California Green Building Standards Code with the respective provisions set forth in this Chapter.

**CHAPTER 5**

**SECTION 503 PERFORMANCE APPROACH.**

This section is hereby amended to read as follows:

**503.1.1 Tier 1.** Exceed the California Energy Code currently in effect by fifteen percent.

**503.2 Minimum energy performance for low-rise residential buildings.** New low-rise residential buildings shall exceed the minimum performance or prescriptive standard design required by the California Energy Code currently in effect by ten percent.

Alterations or additions greater than 100 square feet to existing low-rise residential buildings shall exceed the minimum performance or prescriptive standard design required by the California Energy Code currently in effect by five percent.

**FINDINGS**

**Climatic**—The City of Simi Valley experiences periods of high temperatures averaging 95 degrees during summer months. These conditions result in high peak demands on the City's energy supply and distribution system with the potential of causing disruption of supply or reduction of supply events. The conservation measures incorporated into this code assure that new buildings and additions to existing buildings provide energy efficiency in an effort to reduce the potential for energy supply disruption. For this reason, this jurisdiction determines that these amendments are reasonably necessary.

**TITLE 8. GREEN BUILDING CODE**  
**CHAPTER 22. ADOPTION AND AMENDMENTS OF CALIFORNIA GREEN**  
**BUILDING STANDARDS CODE**

**SECTION 8-22.01 ADOPTION.**

- A. Except as otherwise provided for in this Chapter, The California Green Building Standards Code, Part 11 of Title 24 of the California Code of Regulations, including the matrices and appendices thereto, are approved and adopted, and are hereby incorporated in this Chapter by reference and made a part hereof the same as if fully set forth herein.
- B. One copy of the California Green Building Standards has been filed for use and examination of the public in the Office of the City Clerk of the City of Simi Valley.

**SECTION 8-22.02 CROSS-REFERENCES TO CALIFORNIA GREEN**  
**BUILDING STANDARDS CODE.**

The provisions of this Chapter contain cross-references to the provisions of the California Green Building Standards Code, in order to facilitate reference and comparison to those provisions.

**SECTION 8-22.03 LOCAL AMENDMENTS.**

The provisions of this Chapter shall constitute local amendments to the cross-referenced provisions of the California Green Building Standards Code and shall be deemed to replace the cross-referenced section of the California Green Building Standards Code with the respective provisions set forth in this Chapter.

**CHAPTER 5**

**SECTION 503 PERFORMANCE APPROACH.**

This section is hereby amended to read as follows:

**503.1.1 Tier 1.** Exceed the California Energy Code currently in effect by fifteen percent.

**503.2 Minimum energy performance for low-rise residential buildings.** New low-rise residential buildings shall exceed the minimum performance or prescriptive standard design required by the California Energy Code currently in effect by ten percent.

Alterations or additions greater than 100 square feet to existing low-rise residential buildings shall exceed the minimum performance or prescriptive standard design required by the California Energy Code currently in effect by five percent.

**FINDINGS**

Climatic—The City of Simi Valley experiences periods of high temperatures averaging 95 degrees during summer months. These conditions result in high peak demands on the City's energy supply and distribution system with the potential of causing disruption of supply or reduction of supply events. The conservation measures incorporated into this code assure that new buildings and additions to existing buildings provide energy efficiency in an effort to reduce the potential for energy supply disruption. For this reason, this jurisdiction determines that these amendments are reasonably necessary.

CHAPTER 11  
SECTION AM-BSC APPLICATION MATRIX

This section is hereby amended to read as follows:

APPLICATION MATRIX (AM-BSC)

GREEN BUILDING MEASURE	REQUIRED	VOLUNTARY
<b>PLANNING AND DESIGN</b>		
<b>SITE DEVELOPMENT</b> (406)		
<b>406.1 General.</b> Preservation and use of available natural resources shall be accomplished through evaluation and careful planning to minimize negative effects on the site and adjacent areas. Preservation of slopes, management of storm water drainage and erosion controls shall comply with this section.	<input type="checkbox"/>	
<b>406.2 Storm water drainage and retention during construction.</b> Projects which disturb less than one acre of soil and are not part of a larger common plan of development which in total disturbs one acre or more, shall develop and implement a plan to manage storm water drainage during construction. Use one or more of the following methods:	<input type="checkbox"/>	
3. Compliance with a lawfully enacted storm water management ordinance.	<input type="checkbox"/>	

**FINDING**

Topographical—The City of Simi Valley has a varied topography that requires special drainage and grading precautions. The existence of flood prone areas as identified in Federal Emergency Management Administration Flood Maps require that special consideration and attention be given to protection of buildings and structures subject to potential water damage and erosion. For this reason, jurisdiction determines that these amendments are reasonably necessary.

<b>ENERGY EFFICIENCY</b>		
<b>PERFORMANCE REQUIREMENTS</b> (503)		
<b>503.1 Energy performance.</b> Using an Alternative Calculation Method approved by the California Energy Commission, calculate each nonresidential building's TDV energy and CO2 emissions, and compare it to the standard or "budget" building.		
<b>503.1.1 Tier 1.</b> Exceed the requirements of the California Energy Code by 15 percent.	<input type="checkbox"/>	
<b>503.2 Minimum energy performance for low-rise residential buildings.</b> New buildings shall exceed the performance or prescriptive standard design requirements of the California Energy Code by 10 percent. Alterations or additions greater than 100 square feet shall exceed the performance or prescriptive standard design requirements of the California Energy Code by 5 percent.	<input type="checkbox"/>	
<b>PRESCRIPTIVE MEASURES</b> (504)		
<b>504.1 ENERGY STAR equipment and appliances.</b> All equipment and appliances provided by the builder shall be ENERGY STAR labeled if ENERGY STAR is applicable to that equipment or appliance.	<input type="checkbox"/>	
<b>EFFICIENT STEEL FRAMING</b> (513)		
<b>513.1 Steel framing.</b> Design for and employ techniques to avoid thermal bridging.	<input type="checkbox"/>	

## FINDINGS

**Climatic**—The City of Simi Valley experiences periods of high temperatures averaging 95 degrees during summer months. These conditions result in high peak demands on the City's energy supply and distribution system with the potential of causing disruption of supply or reduction of supply events. These conservation measures incorporated into this code assure that new buildings and additions to existing buildings provide energy efficiency in and effort to reduce the potential for energy supply disruption. For this reason, this jurisdiction determines that these amendments are reasonably necessary.

WATER EFFICIENCY AND CONSERVATION		
OUTDOOR WATER USE (604)		
<p><b>604.2 Potable water reduction.</b> Provide water efficient landscape irrigation design that reduces by 50 percent the use of potable water.</p> <p>Methods used to accomplish the requirements of this section shall include, but not be limited to, the items listed in Section 604.2.</p>	<input type="checkbox"/>	

## FINDINGS

**Climatic**—The City of Simi Valley experiences periods of high temperatures averaging 95 degrees during summer months. These conditions result in high peak demands on the City's energy supply and distribution system with the potential of causing disruption of supply or reduction of supply events. The City experiences low humidity and high winds each year and extended periods of low precipitation. These conditions create very high evaporation rates resulting in increased use of potable water to maintain landscaping. The supply and distribution of potable water, being a finite resource, is subject to over use and potential shortages. The delivery of potable water is energy intensive and the reduction in potable water use will lower energy demands. This conservation measure is incorporated into code to assure new landscape and irrigation systems are designed and constructed to prevent the over use of potable water and reduce the potential of shortages. For this reason, this jurisdiction determines that this amendment is reasonably necessary.

GREEN BUILDING MEASURE	REQUIRED	VOLUNTARY
<b>MATERIAL CONSERVATION AND RESOURCE EFFICIENCY</b>		
<b>WEATHER RESISTANCE AND MOISTURE MANAGEMENT</b> (707)		
<b>707.2 Moisture control.</b> Employ moisture control measures by one of the following methods: <b>707.2.1 Sprinklers.</b> Prevent irrigation spray on structures.	<input type="checkbox"/>	
<b>CONSTRUCTION WASTE REDUCTION, DISPOSAL AND RECYCLING</b> (708)		
<b>708.1 Construction waste diversion.</b> Establish a construction waste management plan or meet local ordinance, whichever is more stringent.	<input type="checkbox"/>	
<b>708.2 Construction waste management plan.</b> Submit plan per this section to enforcement authority.	<input type="checkbox"/>	
<b>708.3 Construction waste.</b> Recycle and/or salvage for reuse a minimum of 75 percent of non-hazardous construction and demolition debris. <b>Exceptions:</b> 1. Excavated soil and land-clearing debris. 2. Alternate waste reduction methods developed by working with local agencies if diversion or recycle facilities capable of compliance with this item do not exist.	<input type="checkbox"/>	

### FINDINGS

**Climatic**—The City of Simi Valley experiences low humidity and high winds each year and extended periods of low precipitation. These conditions create very high evaporation rates resulting in increased use of potable water to maintain landscaping. The supply and distribution of potable water, being a finite resource, is subject to over use and potential shortages. This conservation measure is incorporated into code to assure new sprinkler systems are designed and constructed to prevent the over use of potable water and reduce the potential of shortages. For this reason, this jurisdiction determines that this amendment is reasonably necessary.

**Topographic**—The City of Simi Valley has a varied topography that requires special grading precautions. As a result, the disposal area of the landfill that serves the City is limited in size and the allowed amount of solid waste that may be deposited. This conservation measure is incorporated into code to reduce the amount of solid waste that is deposited in the landfill thereby reducing the amount of grading required for disposal of solid waste, the demand on limited topographic resources. For this reason, this jurisdiction determines that this amendment is reasonably necessary.

<b>ENVIRONMENTAL QUALITY</b>		
<b>FIREPLACES</b> (803)		
<b>803.1</b> Install only a direct-vent sealed-combustion gas or sealed wood-burning fireplace, or a sealed woodstove, and refer to residential requirements in the <i>California Energy Code</i> , Title 24, Part 6, Subchapter 7, Section 150.	<input type="checkbox"/>	

### FINDINGS

**Climatic**—The City of Simi Valley experiences periods of high temperatures averaging 95 degrees during summer months. These conditions result in high peak demands on the City's energy supply and distribution system with the potential of causing disruption of supply or reduction of supply events. The conservation measures incorporated into this code assure that new buildings and additions to existing buildings provide energy efficiency in and effort to reduce the potential for energy supply disruption. For this reason, this jurisdiction determines that these amendments are reasonably necessary.



## **Codes and Standards Title 24 Energy-Efficient Local Ordinances**

**Title:**  
Climate Zone 9  
Energy Cost-Effectiveness Study

**Prepared for:**  
Randall Higa  
Senior Engineer  
Southern California Edison  
626.815.7259  
Email: [Randall.Higa@sce.com](mailto:Randall.Higa@sce.com)

**Prepared by:**  
Michael Gabel  
Gabel Associates, LLC  
510.428.0803  
Email: [mike@gabelenergy.com](mailto:mike@gabelenergy.com)

Last Modified: February 18, 2010



#### **LEGAL NOTICE**

This report was prepared by Southern California Edison Company and funded by the California utility customers under the auspices of the California Public Utilities Commission.

Copyright 2010 Southern California Edison Company. All rights reserved, except that this document may be used, copied, and distributed without modification.

Neither SCE nor any of its employees makes any warranty, express or implied; or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any data, information, method, product, policy or process disclosed in this document; or represents that its use will not infringe any privately-owned rights including, but not limited to, patents, trademarks or copyrights.

**Table of Contents**

- 1.0    *Executive Summary***
- 2.0    *Methodology and Assumptions***
- 3.0    *Minimum Compliance with 2008 Standards***
- 4.0    *Incremental Cost for Exceeding 2008 Standards by 15%***
- 5.0    *Cost Effectiveness Determination***

## **1.0 Executive Summary**

Public Resources Code Section 25402.1(h)2 and Section 10-106 of the Building Energy Efficiency Standards (Standards) establish a process which allows local adoption of energy standards that are more stringent than the statewide Standards. This process allows local governments to adopt and enforce energy standards before the statewide Standards effective date, require additional energy conservation measures, and/or set more stringent energy budgets. Because these energy standards “reach” beyond the minimum requirements of Title 24, Part 6 of the California Building Code, they are commonly referred to as Reach Codes when adopted as a collective set by a local jurisdiction.

The process for adopting a Reach Code requires that local governments apply to the California Energy Commission (CEC) for approval. The applicant jurisdiction must document the supporting analysis for determining that the proposed Reach Code Standards will save more energy than the current statewide Standards. The applicant jurisdiction must also prepare a **Cost Effectiveness Study** that provides the basis of the local government's determination that the proposed Reach Code Standards are cost-effective. Once the CEC staff has verified that the local Reach Code Standards will require buildings to use no more energy than the current statewide Standards and that the documentation requirements in Section 10-106 are met, the application is brought before the full California Energy Commission for approval.

This Cost Effectiveness Study was prepared for Climate Zone 9 which encompasses over 100 cities within Los Angeles and Ventura counties (see Appendix “A” for list of cities). The 2008 Building Energy Efficiency Standards, effective January 1, 2010, have been used as the baseline used in calculating the energy performance of efficiency measures summarized in this study.

## **2.0 Methodology and Assumptions**

The energy performance impacts of exceeding the performance requirements of the 2008 Title 24 Building Energy Efficiency Standards (2008 Standards) have been evaluated in Climate Zone 9 using the following residential and nonresidential prototypical building types:

<b>Small Single Family House</b> 2-story 2,025 sf	<b>Large Single Family House</b> 2-story 4,500 sf
<b>Low-rise Multi-family Apartments</b> 8 dwelling units/2-story 8,442 sf	<b>High-rise Multi-family Apartments</b> 40 dwelling units/4-story 36,800 sf
<b>Low-rise Office Building</b> 1-story 10,580 sf	<b>High-rise Office Building</b> 5-story 52,900 sf

### **Methodology**

The methodology used in the case studies is based on a design process for each of the proposed prototypical building types that first meets the minimum requirements and then exceeds the 2008 Standards by 15%. The process includes the following major stages:

#### ***Stage 1: Minimum Compliance with 2008 Standards:***

Each prototype building design is tested for minimum compliance with the 2008 Standards, and the mix of energy measures are adjusted using common construction options so the building first just meets the Standards. The set of energy measures chosen represent a reasonable combination which reflects how designers, builders and developers are likely to achieve a specified level of performance using a relatively low first incremental (additional) cost

#### ***Stage 2: Incremental Cost for Exceeding 2008 Standards by 15%:***

Starting with that set of measures which is minimally compliant with the 2008 Standards, various energy measures are upgraded so that the building just exceeds the 2008 Standards by 15%. The design choices by the consultant authoring this study are based on many years of experience with architects, builders, mechanical engineers; and general knowledge of the relative acceptance and preferences of many measures, as well as their incremental costs. This approach tends to reflect how building energy performance is typically evaluated for code compliance and how it's used to select design energy efficiency measures. Note that lowest simple payback with respect to building site energy is not the primary focus of selecting measures; but rather the requisite reduction of Title 24 Time Dependent Valuation(TDV) energy at a reasonable

incremental cost consistent with other non-monetary but important design considerations. A minimum and maximum range of incremental costs of added energy efficiency measures is established by a variety of research means. A construction cost estimator, Building Advisory LLC, was contracted to conduct research to obtain current measure cost information for many energy measures; and Gabel Associates performed its own additional research to establish first cost data.

### ***Stage 3 Cost Effectiveness Determination:***

Energy savings in kWh and therms is calculated from the Title 24 simulation results to establish the annual energy cost savings and CO<sub>2</sub>-equivalent reductions in greenhouse gases. A simple payback analysis in years is calculated by dividing the incremental cost for exceeding the 2008 Standards by the estimated annual energy cost savings.

### **Assumptions**

#### ***Annual Energy Cost Savings***

1. Annual site electricity (kWh) and natural gas (therms) saved are calculated using a beta version of the state-approved energy compliance software for the 2008 Building Energy Efficiency Standards, Micropas 8.
2. Average residential utility rates of \$0.159/kWh for electricity and \$0.94/therm for natural gas in current constant dollars; nonresidential rates are time-of-use rate schedules modeled explicitly in the DOE-2.1E computer simulation: Southern California Edison GS-1 schedule for electricity and Southern California Gas GN-10 schedule for natural gas.
3. No change (i.e., no inflation or deflation) of utility rates in constant dollars
4. No increase in summer temperatures from global climate change

#### ***Simple Payback Analysis***

1. No external cost of global climate change -- and corresponding value of additional investment in energy efficiency and CO<sub>2</sub> reduction -- is included
2. The cost of money (e.g., opportunity cost) invested in the incremental cost of energy efficiency measures is not included.

### **3.0 Minimum Compliance with 2008 Standards**

The following energy design descriptions of the following building prototypes just meet the 2008 Standards in Climate Zone 9.

#### **Small Single Family House**

- ☐ 2,025 square feet
- ☐ 2-story
- ☐ 20.2% glazing/floor area ratio

##### **Energy Efficiency Measures**

R-19 Roof w/ Radiant Barrier  
 R-13 Walls  
 R-19 Raised Floor over Garage/Open at 2nd Floor  
 R-0 Slab on Grade  
 Low E2 Vinyl Windows, U=0.36, SHGC=0.30  
 Furnace: 80% AFUE  
 Air Conditioner: 13 SEER  
 R-4.2 Attic Ducts  
 50 Gallon Gas Water Heater: EF=0.62

#### **Large Single Family House**

- ☐ 4,500 square feet
- ☐ 2-story
- ☐ 22.0% glazing/floor area ratio

##### **Energy Efficiency Measures**

R-30 Roof w/ Radiant Barrier  
 R-13 Walls  
 R-19 Raised Floor  
 Quality Insulation Installation (HERS)  
 Low E2 Vinyl Windows, U=0.36, SHGC=0.30  
 (2) Furnaces: 80% AFUE  
 (2) Air Conditioners: 13 SEER, 11 EER (HERS)  
 (2) Air Conditioners: Refrigerant Charge (HERS)  
 R-6 Attic Ducts  
 (2) 50 Gallon Gas Water Heaters: EF=0.61

**Low-rise Multi-family Apartments**

- ☐ 8,442 square feet
- ☐ 8 units/2-story
- ☐ 12.5% glazing/floor area ratio

R-38 Roof w/ Radiant Barrier
R-13 Walls
R-0 Slab on Grade
Low E2 Vinyl Windows, U=0.36, SHGC=0.30
(8) Furnaces: 80% AFUE
(8) Air Conditioners: 13 SEER
R-4.2 Attic Ducts
(8) 40 Gallon Gas Water Heaters: EF=0.63

**High-rise Multifamily Apartments**

- ☐ 36,800 sf,
- ☐ 40 units
- ☐ 4-story
- ☐ Window to Wall Ratio = 35.2%

<b>Energy Efficiency Measures to Meet Title 24</b>
R-19 Metal Roof w/ R-5 (1") rigid insulation; no Cool Roof
R-19 in Metal Frame Walls
R-4 (1.25" K-13 spray-on) Raised Slab over parking garage
Dual Metal Windows: default U-factor=0.79, SHGC=0.79
4-pipe fan coil, 80% AFUE boiler, 80-ton scroll air cooled chiller 0.79 KW/ton
Central DHW boiler: 80% AFUE and recirculating system w/ timer- temperature controls



**Low-rise Office Building**

- ☐ Single Story
- ☐ 10,580 sf,
- ☐ Window to Wall Ratio = 37.1%

<b>Energy Efficiency Measures to Meet Title 24</b>
R-19 under Metal Deck + R-5 (1" rigid); with Cool Roof Reflectance = 0.55, Emittance = 0.75
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
Metal windows: Default glazing U=0.71, COG SHGC=0.54
Lighting = 0.858 w/sf. Open Office Areas: (60) 2-lamp T8 fixtures @58w each; (24) 18w recessed CFLs no lighting controls. Small Offices: (48) 2-lamp T8 fixtures; (40) 18w recessed CFLs, on/off lighting controls. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.
(3) 10-ton DX units EER=11.0; 80% AFUE furnaces; standard efficiency fan motors; fixed temp. integrated air economizers
R-6 duct insulation w/ ducts on roof, HERS verified duct leakage
(1) Tank Gas Water Heaters EF=0.575

**High-rise Office Building**

- ☐ 5-story
- ☐ 52,900 sf,
- ☐ Window to Wall Ratio = 39.4%

**Base Case for Options 1 and 2**

<b>Energy Efficiency Measures to Meet Title 24</b>
R-19 under Metal/Conc. Deck, no cool roof
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
Metal windows: Default U=0.71, COG SHGC=0.54
Lighting = 0.858 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs no lighting controls. Small Offices: (280) 2-lamp T8 fixtures on/off occ. sensors; (200) 18w recessed CFLs on/off occ. sensors. Support Areas: (160) 18w recessed CFLs no lighting controls; (240) 13w CFL wall sconces; no lighting controls.
(5) 35-ton Packaged VAV EER=10.0; 81% TE furnaces; standard efficiency variable speed fan motors; Fixed temp. air economizers; 20% VAV boxes, reheat on perimeter zones with hot water using 85% AFUE boiler
R-6 duct insulation w/ ducts in conditioned
Standard Tank Gas Water Heaters EF=0.58

**Base Case for Option 3**

<b>Energy Efficiency Measures to Meet Title 24</b>
R-19 under Metal/Conc. Deck, no cool roof
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
Metal windows: Default glazing U=0.71, SHGC=0.73
Lighting = 0.858 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs no lighting controls. Small Offices: (280) 2-lamp T8 fixtures on/off occ. sensors; (200) 18w recessed CFLs on/off occ. sensors. Support Areas: (160) 18w recessed CFLs no lighting controls; (240) 13w CFL wall sconces; no lighting controls.
(1) Built Up VAV system with (1) 150 ton reciprocating chiller 1.2 kW/ton and 80% AFUE boiler, standard efficiency vane axial fan motors; 30% VAV boxes, reheat on perimeter zones with hot water using 80% AFUE boiler
R-6 duct insulation w/ ducts in conditioned
Standard Tank Gas Water Heaters EF=0.58

### 3.0 Incremental Cost to Exceed 2008 Standards by 15%

The following tables list the energy features and/or equipment included in the 2008 Standards base design, the efficient measure options, and an estimate of the incremental cost for each measure included to improve the building performance to use 15% less TDV energy than the corresponding Title 24 base case design.

#### Small Single Family House

- ☐ 2,025 square feet
- ☐ 2-story
- ☐ 20.2% glazing/floor area ratio

#### Incremental Cost Estimate to Exceed Title 24 by 15%

Single Family Prototype: 2,025 SF, Option 1

2025 sf

Climate Zone 9

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier (from R-19 w/Radiant Barrier): 1,443 sf @ 0.30 to 0.45/sf	Upgrade	\$ 433	\$ 649	\$ 541
R-13 Walls	-	\$ -	\$ -	\$ -
R-19 Raised Floor over Garage/Open at 2nd Floor	-	\$ -	\$ -	\$ -
R-0 Slab on Grade	-	\$ -	\$ -	\$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	\$ -	\$ -	\$ -
Furnace: 80% AFUE	-	\$ -	\$ -	\$ -
Air Conditioner: 13 SEER, 11 EER (HERS)	Upgrade	\$ 25	\$ 75	\$ 50
Air Conditioner: Refrig. Charge (HERS)	Upgrade	\$ 150	\$ 200	\$ 175
R-4.2 Attic Ducts	-	\$ -	\$ -	\$ -
Reduced Duct Leakage/Testing (HERS)	Upgrade	\$ 300	\$ 600	\$ 450
50 Gallon Gas Water Heater: EF=0.62	-	\$ -	\$ -	\$ -
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 908</b>	<b>\$ 1,524</b>	<b>\$ 1,216</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.45</b>	<b>\$ 0.75</b>	<b>\$ 0.60</b>

**Incremental Cost Estimate to Exceed Title 24 by 15%****Single Family Prototype: 2,025 SF, Option 2****2025 sf****Climate Zone 9**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 Roof w/ Radiant Barrier	-	\$ -	\$ -	\$ -
R-19 Walls (from R-13): 2,550 sf @ \$0.45 to \$0.70/sf	Upgrade	\$ 1,148	\$ 1,785	\$ 1,467
R-19 Raised Floor over Garage/Open at 2nd Floor	-	\$ -	\$ -	\$ -
R-0 Slab on Grade	-	\$ -	\$ -	\$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	\$ -	\$ -	\$ -
Furnace: 80% AFUE	-	\$ -	\$ -	\$ -
Air Conditioner: 13 SEER	-	\$ -	\$ -	\$ -
R-6 Attic Ducts (from R-4.2)	Upgrade	\$ 225	\$ 325	\$ 275
50 Gallon Gas Water Heater: EF=0.62	-	\$ -	\$ -	\$ -
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 1,373</b>	<b>\$ 2,110</b>	<b>\$ 1,742</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.68</b>	<b>\$ 1.04</b>	<b>\$ 0.86</b>

**Incremental Cost Estimate to Exceed Title 24 by 15%****Single Family Prototype: 2,025 SF, Option 3****2025 sf****Climate Zone 9**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier (from R-19 w/Radiant Barrier): 1,443 sf @ 0.30 to 0.45/sf	Upgrade	\$ 433	\$ 649	\$ 541
R-13 Walls	-	\$ -	\$ -	\$ -
R-19 Raised Floor over Garage/Open at 2nd Floor	-	\$ -	\$ -	\$ -
R-0 Slab on Grade	-	\$ -	\$ -	\$ -
Quality Insulation Installation (HERS)	Upgrade	\$ 450	\$ 600	\$ 525
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	\$ -	\$ -	\$ -
Furnace: 80% AFUE	-	\$ -	\$ -	\$ -
Air Conditioner: 13 SEER, 11 EER (HERS)	Upgrade	\$ 25	\$ 75	\$ 50
Air Conditioner: Refrig. Charge (HERS)	Upgrade	\$ 150	\$ 200	\$ 175
R-4.2 Attic Ducts	-	\$ -	\$ -	\$ -
50 Gallon Gas Water Heater: EF=0.62	-	\$ -	\$ -	\$ -
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 1,058</b>	<b>\$ 1,524</b>	<b>\$ 1,291</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.52</b>	<b>\$ 0.75</b>	<b>\$ 0.64</b>

**Large Single Family House**

- ☐ 4,500 square feet
- ☐ 2-story
- ☐ 22.0% glazing/floor area ratio

**Incremental Cost Estimate to Exceed Title 24 by 15%**  
**Single Family Prototype: 4,500 SF, Option 1**

4500 sf

Climate Zone 9

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier	-	\$ -	\$ -	\$ -
R-19 Walls (from R-13): 2,518 sf @ \$0.45 to \$0.70/sf	Upgrade	\$ 1,133	\$ 1,763	\$ 1,448
R-19 Raised Floor	-	\$ -	\$ -	\$ -
Quality Insulation Installation (HERS)	-	\$ -	\$ -	\$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	\$ -	\$ -	\$ -
(2) Furnaces: 80% AFUE	-	\$ -	\$ -	\$ -
(2) Air Conditioners: 13 SEER, 11 EER (HERS)	-	\$ -	\$ -	\$ -
(2) Air Conditioners: Refrig. Charge (HERS)	-	\$ -	\$ -	\$ -
R-6 Attic Ducts	-	\$ -	\$ -	\$ -
Reduced Duct Leakage/Testing (HERS)	Upgrade	\$ 600	\$ 1,200	\$ 900
(2) 50-Gallon Gas Water Heaters: EF=0.60 (from EF=0.61)	Downgrade	\$ (200)	\$ (100)	\$ (150)
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 1,533</b>	<b>\$ 2,863</b>	<b>\$ 2,198</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.34</b>	<b>\$ 0.64</b>	<b>\$ 0.49</b>

**Incremental Cost Estimate to Exceed Title 24 by 15%**  
**Single Family Prototype: 4,500 SF, Option 2**

4500 sf

Climate Zone 9

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier	-	\$ -	\$ -	\$ -
R-13 Walls	-	\$ -	\$ -	\$ -
R-19 Raised Floor	-	\$ -	\$ -	\$ -
Quality Insulation Installation (HERS)	-	\$ -	\$ -	\$ -
Super Low E Vinyl Windows, U=0.36, SHGC=0.23 (from Low E2, U=0.36, SHGC=0.30): 990 sf @ \$1.40 - \$1.75 /sf	Upgrade	\$ 1,386	\$ 1,733	\$ 1,559
(2) Furnaces: 80% AFUE	-	\$ -	\$ -	\$ -
(2) Air Conditioners: 13 SEER, 11 EER (HERS)	-	\$ -	\$ -	\$ -
(2) Air Conditioners: Refrig. Charge (HERS)	-	\$ -	\$ -	\$ -
R-6 Attic Ducts	-	\$ -	\$ -	\$ -
Reduced Duct Leakage/Testing (HERS)	Upgrade	\$ 600	\$ 1,200	\$ 900
(2) 50 Gallon Gas Water Heaters: EF=0.60 (from EF=0.61)	Downgrade	\$ (200)	\$ (100)	\$ (150)
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 1,786</b>	<b>\$ 2,833</b>	<b>\$ 2,309</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.40</b>	<b>\$ 0.63</b>	<b>\$ 0.51</b>

**Incremental Cost Estimate to Exceed Title 24 by 15%**  
**Single Family Prototype: 4,500 SF, Option 3**

4500 sf

Climate Zone 9

Energy Efficiency Measures	Change	Incremental Cost Estimate		
R-30 Roof w/ Radiant Barrier	-	\$ -	\$ -	\$ -
R-21 Walls (from R-13): 2,518 sf @ \$0.60 to \$0.85/sf	Upgrade	\$ 1,511	\$ 2,140	\$ 1,826
R-19 Raised Floor	-	\$ -	\$ -	\$ -
Quality Insulation Installation (HERS)	-	\$ -	\$ -	\$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	\$ -	\$ -	\$ -
(2) Furnaces: 80% AFUE	-	\$ -	\$ -	\$ -
(2) Air Conditioners: 13 SEER, 11 EER (HERS)	-	\$ -	\$ -	\$ -
(2) Air Conditioners: Refrig. Charge (HERS)	-	\$ -	\$ -	\$ -
R-4.2 Attic Ducts (from R-6)	Downgrade	\$ (650)	\$ (450)	\$ (550)
Reduced Duct Leakage/Testing (HERS)	Upgrade	\$ 600	\$ 1,200	\$ 900
(2) 50 Gallon Gas Water Heaters: EF=0.62 (from EF=0.61)	Upgrade	\$ 100	\$ 200	\$ 150
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 1,561</b>	<b>\$ 3,090</b>	<b>\$ 2,326</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.35</b>	<b>\$ 0.69</b>	<b>\$ 0.52</b>

**Low-rise Multi-family Apartments**

- ☐ 8,442 square feet
- ☐ 8 units/2-story
- ☐ 12.5% glazing/floor area ratio

**Incremental Cost Estimate to Exceed Title 24 by 15%**  
**Multi-Family Prototype: 8,442 SF, Option 1**

8442 sf

Climate Zone 9

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier (from R-38 w/Radiant Barrier): 4,221 sf @ 0.15 to 0.20/sf	Downgrade	\$ (844)	\$ (633)	\$ (739)
R-21 Walls (from R-13): 10,146 sf @ \$0.60 to \$0.85/sf	Upgrade	\$ 6,088	\$ 8,624	\$ 7,356
R-0 Slab on Grade	-	\$ -	\$ -	\$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	\$ -	\$ -	\$ -
(8) Furnaces: 80% AFUE	-	\$ -	\$ -	\$ -
(8) Air Conditioner: 13 SEER, 11 EER (HERS)	Upgrade	\$ 200	\$ 600	\$ 400
R-4.2 Attic Ducts	-	\$ -	\$ -	\$ -
(8) 40 Gallon Gas Water Heaters: EF=0.63	-	\$ -	\$ -	\$ -
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 5,444</b>	<b>\$ 8,591</b>	<b>\$ 7,017</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.64</b>	<b>\$ 1.02</b>	<b>\$ 0.83</b>

**Incremental Cost Estimate to Exceed Title 24 by 15%****Multi-Family Prototype: 8,442 SF, Option 2****8442 sf****Climate Zone 9**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier (from R-38 w/Radiant Barrier): 4,221 sf @ 0.15 to 0.20/sf	Downgrade	\$ (844)	\$ (633)	\$ (739)
R-15 Walls (from R-13): 10,146 sf @ \$0.14 to \$0.18/sf	Upgrade	\$ 1,420	\$ 1,826	\$ 1,623
R-0 Slab on Grade	-	\$ -	\$ -	\$ -
Quality Insulation Installation (HERS)	Upgrade	\$ 1,800	\$ 2,400	\$ 2,100
Super Low E Vinyl, U=0.36, SHGC=0.23 (from Low E2 Vinyl Windows, U=0.36, SHGC=0.30): 1055 sf @ \$1.40 - \$1.75 / sf	Upgrade	\$ 1,477	\$ 1,846	\$ 1,662
(8) Furnaces: 80% AFUE	-	\$ -	\$ -	\$ -
(8) Air Conditioner: 13 SEER, 11 EER (HERS)	Upgrade	\$ 200	\$ 600	\$ 400
(8) Air Conditioners: Refrig. Charge (HERS)	Upgrade	\$ 1,200	\$ 1,600	\$ 1,400
R-4.2 Attic Ducts	-	\$ -	\$ -	\$ -
(8) 40 Gallon Gas Water Heaters: EF=0.63	-	\$ -	\$ -	\$ -
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 5,253</b>	<b>\$ 7,639</b>	<b>\$ 6,446</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.62</b>	<b>\$ 0.90</b>	<b>\$ 0.76</b>

**Incremental Cost Estimate to Exceed Title 24 by 15%****Multi-Family Prototype: 8,442 SF, Option 3****8442 sf****Climate Zone 9**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier (from R-38 w/Radiant Barrier): 4,221 sf @ 0.15 to 0.20/sf	Downgrade	\$ (844)	\$ (633)	\$ (739)
R-19 Walls (from R-13): 10,146 sf @ \$0.45 to \$0.70/sf	Upgrade	\$ 4,566	\$ 7,102	\$ 5,834
R-0 Slab on Grade	-	\$ -	\$ -	\$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	\$ -	\$ -	\$ -
(8) Furnaces: 80% AFUE	-	\$ -	\$ -	\$ -
(8) Air Conditioner: 13 SEER, 11 EER (HERS)	Upgrade	\$ 200	\$ 600	\$ 400
(8) Air Conditioners: Refrig. Charge (HERS)	Upgrade	\$ 1,200	\$ 1,600	\$ 1,400
R-4.2 Attic Ducts	-	\$ -	\$ -	\$ -
(8) 40 Gallon Gas Water Heaters: EF=0.63	-	\$ -	\$ -	\$ -
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 5,966</b>	<b>\$ 9,302</b>	<b>\$ 7,634</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.71</b>	<b>\$ 1.10</b>	<b>\$ 0.90</b>

### High-rise Multifamily Apartments

- ☐ 36,800 sf,
- ☐ 40 units/4-story
- ☐ Window to Wall Ratio = 35.2%

#### Incremental Cost Estimate to Exceed Title 24 by 15%

#### High-rise Residential Prototype: 36,800 SF, Option 1

Climate Zone 9

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 Metal Roof w/ R-5 (1") rigid insulation; no Cool Roof	-	\$ -	\$ -	\$ -
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-4 (1.25" K-13 spray-on) Raised Slab over parking garage	-	\$ -	\$ -	\$ -
Dual Metal Windows: <b>COG U-factor=0.3, COG SHGC=0.38;</b> 6,240 sf @ \$2.50 to \$4.00/sf	Upgrade	\$ 15,600	\$ 24,960	\$ 20,280
4-pipe fan coil, 80% AFUE boiler, 80-ton scroll air cooled chiller 0.79 KW/ton	-	\$ -	\$ -	\$ -
Central DHW boiler: 80% AFUE and recirculating system w/ timer- temperature controls	-	\$ -	\$ -	\$ -
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 15,600</b>	<b>\$ 24,960</b>	<b>\$ 20,280</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.42</b>	<b>\$ 0.68</b>	<b>\$ 0.55</b>

#### Incremental Cost Estimate to Exceed Title 24 by 15%

#### High-rise Residential Prototype: 36,800 SF, Option 2

Climate Zone 9

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 Metal Roof w/ <b>R-10 (2")</b> rigid insulation; <b>Cool Roof</b> <b>Reflectance=0.30, Emittance=0.75;</b> 9,200 sf @ \$1.10 - \$1.50/sf	Upgrade	\$ 10,120	\$ 13,800	\$ 11,960
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-4 (1.25" K-13 spray-on) Raised Slab over parking garage	-	\$ -	\$ -	\$ -
Dual Metal Windows: <b>COG U-factor=0.3, COG SHGC=0.54;</b> 6,240 sf @ \$2.00 to \$3.50/sf	Upgrade	\$ 12,480	\$ 17,472	\$ 14,976
4-pipe fan coil, <b>84% AFUE</b> boiler, 80-ton scroll air cooled chiller 0.79 KW/ton	Upgrade	\$ 1,250	\$ 2,000	\$ 1,625
Central DHW boiler: <b>84% AFUE</b> and recirculating system w/ timer- temperature controls	Upgrade	\$ 1,250	\$ 2,000	\$ 1,625
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 25,100</b>	<b>\$ 35,272</b>	<b>\$ 30,186</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.68</b>	<b>\$ 0.96</b>	<b>\$ 0.82</b>



**Incremental Cost Estimate to Exceed Title 24 by 15%**  
**High-rise Residential Prototype: 36,800 SF, Option 3**

**Climate Zone 9**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 Metal Roof w/ <b>R-10 (2")</b> rigid insulation; no Cool Roof; 9,200 sf @ \$0.75 - \$1.00/sf	Upgrade	\$ 6,900	\$ 9,200	\$ 8,050
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-4 (1.25" K-13 spray-on) Raised Slab over parking garage	-	\$ -	\$ -	\$ -
<b>Dual Non-Metal Windows: default U-factor=0.58, COG SHGC=0.38; 6,240 sf @ \$2.00 to \$3.50/sf</b>	Upgrade	\$ 12,480	\$ 17,472	\$ 14,976
4-pipe fan coil, 80% AFUE boiler, 80-ton scroll air cooled chiller 0.79 kW/ton	-	\$ -	\$ -	\$ -
Central DHW boiler: 80% AFUE and recirculating system w/ timer-temperature controls	-	\$ -	\$ -	\$ -
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 19,380</b>	<b>\$ 26,672</b>	<b>\$ 23,026</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.53</b>	<b>\$ 0.72</b>	<b>\$ 0.63</b>

**Low-rise Office Building**

- ☐ Single Story
- ☐ 10,580 sf,
- ☐ Window to Wall Ratio = 37.1%

**Incremental Cost Estimate to Exceed Title 24 by 15%****Nonresidential Prototype: 10,580 SF, Option 1****Climate Zone 9**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 under Metal Deck + <b>R-10 (2" rigid)</b> ; Cool Roof Reflectance =0.55, Emittance =0.75; 10,580 sf @ \$1.10 to \$1.50/sf	Upgrade	\$ 11,638	\$ 15,870	\$ 13,754
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	\$ -	\$ -	\$ -
Metal windows: <b>COG U=0.30, COG SHGC=0.27</b> ; 3,200 sf @ \$2.50 to \$4.00/sf	Upgrade	\$ 8,000	\$ 12,800	\$ 10,400
Lighting = 0.858 w/sf. Open Office Areas: (60) 2-lamp T8 fixtures @58w each; (24) 18w recessed CFLs no lighting controls. Small Offices: (48) 2-lamp T8 fixtures; (40) 18w recessed CFLs, on/off lighting controls. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.	-	\$ -	\$ -	\$ -
(3) 10-ton DX units EER=11.0; 80% AFUE furnaces; standard efficiency fan motors; fixed temp. integrated air economizers, <b>Cycle on at night</b>	Upgrade	\$ 300	\$ 600	\$ 450
R-6 duct insulation w/ ducts on roof, HERS verified duct leakage	-	\$ -	\$ -	\$ -
(1) Gas Tank Water Heater EF=0.575	-	\$ -	\$ -	\$ -
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 19,938</b>	<b>\$ 29,270</b>	<b>\$ 24,604</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 1.88</b>	<b>\$ 2.77</b>	<b>\$ 2.33</b>

**Incremental Cost Estimate to Exceed Title 24 by 15%**  
**Nonresidential Prototype: 10,580 SF, Option 2**

**Climate Zone 9**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 under Metal Deck + <b>R-10 (2" rigid)</b> ; Cool Roof Reflectance =0.55, Emittance = 0.75; 10,580 sf @ \$1.10 to \$1.50/sf	Upgrade	\$ 11,638	\$ 15,870	\$ 13,754
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	\$ -	\$ -	\$ -
Metal windows: <b>COG U=0.30, COG SHGC=0.38</b> ; 3,200 sf @ \$2.00 to \$3.50/sf	Upgrade	\$ 6,400	\$ 11,200	\$ 8,800
Lighting = 0.783 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; no lighting controls; (24) 18w recessed CFLs. Small Offices: (56) 2-lamp T8 fixtures, <b>(28) multi-level occupancy sensors on T8s @ \$75 to \$100 each</b> ; (40) 18w recessed CFLs Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.	Upgrade	\$ 2,100	\$ 2,800	\$ 2,450
(3) 10-ton DX units EER=11.0; 80% AFUE furnaces; standard efficiency fan motors; fixed temp. integrated air economizers, <b>Cycle on at night</b>	Upgrade	\$ 300	\$ 600	\$ 450
R-6 duct insulation w/ ducts on roof, HERS verified duct leakage	-	\$ -	\$ -	\$ -
<b>(1) Tankless Gas Water Heater EF=0.85</b>	Upgrade	\$ 1,200	\$ 2,500	\$ 1,850
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 21,638</b>	<b>\$ 32,970</b>	<b>\$ 27,304</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 2.05</b>	<b>\$ 3.12</b>	<b>\$ 2.58</b>

**Incremental Cost Estimate to Exceed Title 24 by 15%****Nonresidential Prototype: 10,580 SF, Option 3****Climate Zone 9**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 under Metal Deck + <b>R-10 (2" rigid)</b> ; Cool-Roof Reflectance = 0.55, Emittance = 0.75; 10,580 sf @ \$1.10 to \$1.50/sf	Upgrade	\$ 11,638	\$ 15,870	\$ 13,754
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	\$ -	\$ -	\$ -
Metal windows: Default glazing U=0.71, SHGC=0.73	Downgrade	\$ (3,200)	\$ (4,800)	\$ (4,000)
Lighting = 0.797 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; no lighting controls; (24) 18w recessed CFLs. Small Offices: (56) 2-lamp T8 fixtures, <b>(28) multi-level occupancy sensors on T8s @ \$75 to \$100 each</b> ; (40) 18w recessed CFLs on/off lighting controls. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no-controls.	Upgrade	\$ 2,100	\$ 2,800	\$ 2,450
<b>(6) 5-ton Packaged DX units SEER=14.0; 80% AFUE furnaces; premium efficiency variable speed fan motors; fixed temp. integrated air economizers; @ \$300/ton to \$400/ton for increasing number and changing type of DX units</b>	Upgrade	\$ 9,000	\$ 12,000	\$ 10,500
R-6 duct insulation w/ ducts on roof, HERS verified duct leakage	-	\$ -	\$ -	\$ -
(1) Tank Gas Water Heaters EF=0.575	-	\$ -	\$ -	\$ -
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 19,538</b>	<b>\$ 25,870</b>	<b>\$ 22,704</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 1.85</b>	<b>\$ 2.45</b>	<b>\$ 2.15</b>

**Incremental Cost Estimate to Exceed Title 24 by 15%****Nonresidential Prototype: 10,580 SF, Option 4****Climate Zone 9**

<b>Energy Efficiency Measures to Exceed Title 24 by 15%</b>	<b>Change Type</b>	<b>Incremental Cost Estimate</b>		
		<b>Min</b>	<b>Max</b>	<b>Avg</b>
R-19 under Metal Deck + R-5 (1" rigid); with cool roof Aged = .55 TE = .75	-	\$ -	\$ -	\$ -
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	\$ -	\$ -	\$ -
Metal windows: Default glazing U=0.71, COG SHGC=0.54	-	\$ -	\$ -	\$ -
Lighting = 0.858 w/sf. Open Office Areas: (60) 2-lamp T8 fixtures @58w each; (24) 18w recessed CFLs no lighting controls. Small Offices: (48) 2-lamp T8 fixtures; (40) 18w recessed CFLs, on/off lighting controls. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.	-	\$ -	\$ -	\$ -
<b>(6) 5-ton Packaged DX units SEER=14.0; 80% AFUE furnaces; premium efficiency variable speed fan motors; fixed temp. integrated air economizers; @ \$300/ton to \$400/ton for increasing number and changing type of DX units</b>	Upgrade	\$ 9,000	\$ 12,000	\$ 10,500
R-6 duct insulation w/ ducts on roof, HERS verified duct leakage	-	\$ -	\$ -	\$ -
(1) Gas Tank Water Heater EF=0.575	-	\$ -	\$ -	\$ -
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 9,000</b>	<b>\$ 12,000</b>	<b>\$ 10,500</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.85</b>	<b>\$ 1.13</b>	<b>\$ 0.99</b>

**High-rise Office Building**

- ☐ 5-story
- ☐ 52,900 sf,
- ☐ Window to Wall Ratio = 39.4%

**Incremental Cost Estimate to Exceed Title 24 by 15%****Nonresidential Prototype: 52,900 SF, Option 1****Climate Zone 9**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 under Metal/Conc. Deck: <b>cool roof Reflect=0.55, Emittance=0.75</b> ; 10,580-sf @ \$0.35 to \$0.50/sf	Upgrade	\$ 3,703	\$ 5,290	\$ 4,497
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	\$ -	\$ -	\$ -
Metal windows: <b>COG U=0.30, COG SHGC=0.27</b> ; 16,000 sf @ \$2.00 to \$2.50/sf	Upgrade	\$ 32,000	\$ 40,000	\$ 36,000
Lighting = 0.858 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs no lighting controls. Small Offices: (280) 2-lamp T8 fixtures on/off occ. sensors; (200) 18w recessed CFLs on/off occ. sensors. Support Areas: (160) 18w recessed CFLs no lighting controls; (240) 13w CFL wall sconces; no lighting controls.	-	\$ -	\$ -	\$ -
(5) 35-ton Packaged VAV EER=10.0; 81% TE furnaces; standard efficiency variable speed fan motors; Fixed temp. air economizers; 20% VAV boxes, reheat on perimeter zones with hot water using 85% AFUE boiler	-	\$ -	\$ -	\$ -
R-6 duct insulation w/ ducts in conditioned	-	\$ -	\$ -	\$ -
Standard Tank Gas Water Heaters EF=0.58	-	\$ -	\$ -	\$ -
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 35,703</b>	<b>\$ 45,290</b>	<b>\$ 40,497</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.67</b>	<b>\$ 0.86</b>	<b>\$ 0.77</b>

**Incremental Cost Estimate to Exceed Title 24 by 15%**  
**Nonresidential Prototype: 52,900 SF, Option 2**

**Climate Zone 9**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 under Metal/Conc. Deck: <b>cool roof Reflect=0.55, Emittance=0.75</b> ; 10,580 sf @ \$1.50 to \$2.65/sf	Upgrade	\$ 15,870	\$ 28,037	\$ 21,954
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	\$ -	\$ -	\$ -
Metal windows: Default U=0.71, COG SHGC=0.38; 16,000 sf @ \$1.50 to \$2.00/sf	Upgrade	\$ 24,000	\$ 32,000	\$ 28,000
Lighting = 0.692 w/sf: Open Office Areas: <b>(160) HO 2-lamp T8 fixtures @74w each</b> ; no lighting controls; (120) 18w recessed CFLs no lighting controls. Small Offices: (140) 2-lamp T8 fixtures <b>multi-level occupancy sensors on T8s @ \$75 to \$100 each</b> ; (200) 18w recessed CFLs on/off lighting controls. Support Areas: (160) 18w recessed CFLs no lighting controls; (240) 13w CFL wall sconces; no lighting controls. Net saving of \$36 to \$40 per new fixture in open offices because of a total reduction of 46% of T8 fixtures in these areas	Upgrade	\$ 4,740	\$ 7,600	\$ 6,170
(5) 35-ton Packaged VAV EER=10.0; 81% TE furnaces; <b>premium</b> efficiency variable speed fan motors; Fixed temp. air economizers; 20% VAV boxes; reheat on perimeter zones with hot water using <b>93% AFUE</b> boiler (cost of boiler below)	Upgrade	\$ 1,500	\$ 2,500	\$ 2,000
R-6 duct insulation w/ ducts in conditioned	-	\$ -	\$ -	\$ -
<b>(1) Boiler with 93% AFUE for service hot water</b>	Upgrade	\$ 5,000	\$ 8,000	\$ 6,500
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 51,110</b>	<b>\$ 78,137</b>	<b>\$ 64,624</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 0.97</b>	<b>\$ 1.48</b>	<b>\$ 1.22</b>

**Incremental Cost Estimate to Exceed Title 24 by 15%**  
**Nonresidential Prototype: 52,900 SF, Option 3**

**Climate Zone 9**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 under Metal/Conc. Deck: no cool roof	-	\$ -	\$ -	\$ -
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	\$ -	\$ -	\$ -
Metal windows: Default U=0.71, <b>COG SHGC=0.54</b> ; 16,000 sf @ \$2.50 to \$4.00/sf	Upgrade	\$ 40,000	\$ 64,000	\$ 52,000
Lighting = 0.858 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs no lighting controls. Small Offices: (280) 2-lamp T8 fixtures on/off occ. sensors; (200) 18w recessed CFLs on/off occ. sensors. Support Areas: (160) 18w recessed CFLs no lighting controls; (240) 13w CFL wall sconces; no lighting controls.	-	\$ -	\$ -	\$ -
(1) Built Up VAV system with (1) 150 ton reciprocating chiller 1.2 kW/ton and <b>93% AFUE boiler</b> , standard efficiency <b>variable speed fan motors</b> ; <b>20% VAV boxes</b> , reheat on perimeter zones (cost of boiler below)	Upgrade	\$ 25,000	\$ 35,000	\$ 30,000
R-6 duct insulation w/ ducts in conditioned	-	\$ -	\$ -	\$ -
<b>(1) Boiler with 93% AFUE for service hot water</b>	Upgrade	\$ 5,000	\$ 8,000	\$ 6,500
<b>Total Incremental Cost of Energy Efficiency Measures:</b>		<b>\$ 70,000</b>	<b>\$ 107,000</b>	<b>\$ 88,500</b>
<b>Total Incremental Cost per Square Foot:</b>		<b>\$ 1.32</b>	<b>\$ 2.02</b>	<b>\$ 1.67</b>



## 5.0 Cost Effectiveness Determination

Regardless of the building design, occupancy profile and number of stories, the incremental improvement in overall annual energy performance of buildings in exceeding the 2008 Standards is determined to be cost-effective. However, each building's overall design, occupancy type and specific design choices may allow for a large range of incremental costs for exceeding 2008 Standards, estimated annual energy cost savings, and subsequent payback period.

### Small Single Family

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost (\$)	Annual Energy Cost Savings (\$)	Simple Payback (Years)
2,025 sf (Option 1)	400	27	\$1,216	\$89	13.7
2,025 sf (Option 2)	376	37	\$1,742	\$95	18.4
2,025 sf (Option 3)	394	30	\$1,291	\$91	14.2
Averages:	390	31	\$1,416	\$91	15.4

**Annual Reduction in CO2-equivalent:** 540 lb./building-year  
0.27 lb./sq.ft.-year

### Large Single Family

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost (\$)	Annual Energy Cost Savings (\$)	Simple Payback (Years)
4,500 sf (Option 1)	619	48	\$2,198	\$144	15.3
4,500 sf (Option 2)	914	-1	\$2,310	\$144	16.0
4,500 sf (Option 3)	567	61	\$2,326	\$147	15.8
Averages:	700	36	\$2,278	\$145	15.7

**Annual Reduction in CO2-equivalent:** 734 lb./building-year  
0.16 lb./sq.ft.-year

### Low-rise Multi-family Apartments

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost (\$)	Annual Energy Cost Savings (\$)	Simple Payback (Years)
8-Unit, 8,442 sf (Option 1)	1625	126	\$7,018	\$377	18.6
8-Unit, 8,442 sf (Option 2)	2037	58	\$6,446	\$378	17.0
8-Unit, 8,442 sf (Option 3)	1757	107	\$7,634	\$380	20.1
Averages:	1806	97	\$7,033	\$378	18.6

**Annual Reduction in CO2-equivalent:** 1,942 lb./building-year  
0.23 lb./sq.ft.-year

### High-rise Multi-family Apartments

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost (\$)	Annual Energy Cost Savings (\$)	Simple Payback (Years)
36,800 sf (Option 1)	15503	-361	\$20,280	\$2,126	9.5
36,800 sf (Option 2)	10998	-188	\$30,186	\$1,925	15.7
36,800 sf (Option 3)	16531	-287	\$23,026	\$2,359	9.8
Averages:	14344	-153	\$24,497	\$2,137	11.7

**Annual Reduction in CO<sub>2</sub>-equivalent:** 4,670 lb./building-year  
0.13 lb./sq.ft.-year

### Low-rise Office Building

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost (\$)	Annual Energy Cost Savings (\$)	Simple Payback (Years)
10,580 sf (Option 1)	10509	-30	\$30,658	\$2,255	13.6
10,580 sf (Option 2)	8333	166	\$27,304	\$1,876	14.6
10,580 sf (Option 3)	24507	25	\$24,161	\$5,517	4.4
10,580 sf (Option 4)	26034	-80	\$10,500	\$5,741	1.8
Averages:	17346	20	\$23,156	\$3,847	8.6

**Annual Reduction in CO<sub>2</sub>-equivalent:** 8,041 lb./building-year  
0.76 lb./sq.ft.-year

### High-rise Office Building

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost (\$)	Annual Energy Cost Savings (\$)	Simple Payback (Years)
52,900 sf (Option 1)	46359	-1305	\$40,497	\$10,151	4.0
52,900 sf (Option 2)	65339	91	\$64,624	\$14,819	4.4
52,900 sf (Option 3)	69159	511	\$88,500	\$15,874	5.6
Averages:	60286	-234	\$64,540	\$13,615	4.6

**Annual Reduction in CO<sub>2</sub>-equivalent:** 24,401 lb./building-year  
0.46 lb./sq.ft.-year

## Appendix "A"

### Climate Zone 9 Cities

1	Agoura Hills	31	El Monte
2	Agua Dulce	32	Encino
3	Alhambra	33	Fillmore
4	Altadena	34	Glendale
5	Arcadia	35	Glendora
6	Avocado Heights	36	Granada Hills
7	Azusa	37	Hacienda Heights
8	Baldwin Park	38	Hidden Hills
9	Bardsdale	39	Highland Park
10	Bassett	40	Hollywood
11	Beverly Hills	41	Industry
12	Bradbury	42	Irwindale
13	Burbank	43	La Canada Flintridge
14	Calabasas	44	La Crescenta
15	Canoga Park	45	La Mirada
16	Casitas Springs	46	La Puente
17	Castaic	47	La Verne
18	Charter Oak	48	Ladera Heights
19	Chatsworth	49	Lake Casitas
20	City Terrace	50	Los Nietos
21	Claremont	51	Marina del Rey
22	Cornell	52	Mira Canyon
23	Covina	53	Monrovia
24	Diamond Bar	54	Montebello
25	Duarte	55	Monterey Park
26	East La Mirada	56	Montrose
27	East Los Angeles	57	Moorpark
28	East Pasadena	58	Newbury Park
29	East San Gabriel	59	Newhall
30	East Whittier	60	North Hollywood

### **Climate Zone 9 Cities – con't**

61 Northridge	91 Solemint
62 Oak Ridge	92 South El Monte
63 Oak View	93 South Pasadena
64 Ojai	94 South San Gabriel
65 Pacoima	95 South Whittier
66 Panorama City	96 Studio City
67 Pasadena	97 Sulphur Springs
68 Pico Rivera	98 Sun Valley
69 Piru	99 Sunland
70 Pomona	100 Sylmar
71 Reseda	101 Tarzana
72 Rosemead	102 Temple City
73 Rowland Heights	103 Thousand Oaks
74 San Dimas	104 Tujunga
75 San Fernando	105 UCLA
76 San Fernando Valley	106 Val Verde Park
77 San Gabriel	107 Valencia
78 San Gabriel Mountains	108 Valinda
79 San Marino	109 Van Nuys
80 Santa Clarita	110 Verdugo Mountains
81 Santa Fe Springs	111 Walnut
82 Santa Paula	112 West Covina
83 Santa Susana	113 West Hollywood
84 Saugus	114 West Puente Valley
85 Sepulveda	115 West Whittier-Los Nietos
86 Sepulveda Dam	116 Westlake Village
87 Sespe	117 Whittier
88 Sherman Oaks	118 Whittier Narrows Dam
89 Sierra Madre	119 Woodland Hills
90 Simi Valley	



